

**Tringa ochropus** L.

A flock of five birds were seen on 2 July near Candia, out of which a pair were shot. They were in complete breeding plumage, were very fat, and showed no signs of having bred.

*Larus argentatus cachinnans* was common off the coast near Candia, and had bred in a large colony on Paximadi Island; a young bird was found in the nest, but all the rest were on the wing.

*Puffinus puffinus yelkouan* and *Procellaria pelagica* were common at sea off eastern Crete throughout June, but I could not locate any breeding quarters.

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VII.—*On the Economic Status of the Kingfisher*, *Alcedo ispida* Linn. By WALTER E. COLLINGE, D.Sc., F.L.S., M.B.O.U.

(Text-figure 2.)

I. *Introduction.*

THE brilliant external colouring of the Kingfisher (*Alcedo ispida* Linn.) makes it one of the most beautiful birds we have in this country, in consequence of which Yarrell (10) states, it is "so much sought after by the idle and thoughtless that its numbers, probably never very great in any part of the country, have of late years very sensibly decreased . . . but the most constant persecution the species undergoes arises rather from the delight . . . so many people take in possessing its stuffed skin; . . . and to this end more Kingfishers are probably shot or netted for English bird-stuffers than any other species." Although this statement was made nearly fifty years ago, it is equally true to-day. So recently as 1891 Mr. A. H. Cocks (2) reported that a local bird-stuffer had nearly a hundred Kingfishers sent to him to set up that year.

Further, as a frequenter of streams, brooks, and rivers, this bird has generally been regarded as injurious to fish-culture, and consequently has been ruthlessly shot.

Some little time ago the writer was appealed to for some definite information as to the precise nature of the food of the Kingfisher. Unfortunately, as in the case of so many other British birds, no such information was available; the present investigation was therefore undertaken.

The results here set forth are based upon the examination of 120 nest-contents, obtained from sixteen counties; 53 pellets; and the stomach-contents of 27 birds obtained from eight counties during all the months of the year excepting May, June, and December. Numerous field observations have also been made.

The method adopted throughout for estimating the food percentages is that known as the volumetric one (3).

TABLE I.—Showing number of adult Kingfishers and nest-contents examined in this investigation, arranged to show locality and month in which collected.

County.	Jan.	Feb.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.	
													Birds.	Nests.
Bedford ...	...	...	1/2	...	...	...	1/2	1/3	1/3	...	...	...	4	10
Cheshire ...	...	1/	1/	...	...	...	/1	1/1	/2	/2	...	...	3	6
Cumberland.	/2	/2	...	1/	...	...	...	/2	1/6	/1	/1	...	2	14
Devon .....	...	...	...	...	...	...	...	/3	/1	/2	...	...	0	6
Dorset .....	/4	...	...	...	...	...	...	...	...	/2	/1	...	0	7
Hants .....	...	...	...	...	...	...	...	...	...	/3	/1	/2	0	6
Hereford ...	...	1/	1/	1/	...	...	1/	1/4	/3	1/2	...	...	6	9
Leicester ...	...	...	...	...	...	...	...	...	/2	/5	/1	...	0	8
Lincoln ...	...	/2	/1	...	...	...	...	...	...	...	...	/1	0	4
Middlesex ...	1/	...	1/	1/	...	...	...	...	1/7	/4	1/	...	5	11
Nottingham.	...	...	...	...	...	...	...	1/	...	1/3	...	...	2	3
Norfolk ...	...	...	...	...	...	...	...	...	/2	...	/2	...	0	4
Warwick ...	...	...	...	1/	...	...	...	/3	/2	...	/1	...	1	6
Worcester .	...	/2	1/	1/	...	...	...	...	1/5	1/2	/1	...	4	10
Yorkshire ...	/5	...	...	...	...	/4	...	...	/2	/3	...	...	0	14
Ireland .....	...	...	...	/1	...	/1	...	...	...	...	...	...	0	2
Totals ...	1/11	2/6	5/3	5/1	...	/5	2/3	4/16	4/35	3/29	1/8	/3	27+120	

The figures on the left denote the number of birds, and those on the right the number of nest-contents.

I acknowledge with many thanks the kindness of the Carnegie Trust for the Universities of Scotland, in defraying the whole of the expenses in connection with this investigation.

## II. *Historical.*

References to the food and feeding habits of the Kingfisher are exceedingly few. Yarrell (10) states: "Its food consists of small crustaceans, aquatic insects, such as dragonflies, water-beetles, and little fishes—especially minnows and sticklebacks, while leeches are also said to enter into its diet."

Butler (1) writes: "Although very fond of small fish, these by no means constitute the sole food of the Kingfisher, for it is very fond of tadpoles and water-beetles; moreover, many of the small fry which are eaten are quite useless for human consumption, so that the bird has been treated with undeserved severity by pisciculturists, many of whom lose no opportunity of shooting it."

Newstead (8) examined the stomach-contents of nineteen specimens, in most of which he found minute and small fish-bones, one small gudgeon (*Gobio fluviatilis*), and remains of several water-boatmen (*Notonecta glauca*).

Forbush (4) refers to the American species as eating grasshoppers, and Mason (7) quotes certain authorities as to *A. ispida*, in India, feeding upon small fishes, tadpoles, and aquatic insects.

## III. *Field Investigations.*

1. *Abundance.*—So far as I can learn from information supplied by different correspondents, the number of nesting sites has decreased during the last ten or twelve years, particularly in the following counties:—Cumberland, Cheshire, Devon, Hereford, Leicester, Middlesex, Warwick, Worcester, and Yorkshire.

Messrs. Jourdain and Witherby (5), in their valuable report on the effect of the winter 1916–1917 on our resident birds, state: "The diminution in the breeding stock is

shown by the fact that whilst most of its favourite breeding places on the lower reaches of the Thames were occupied in 1917, the upper reaches were deserted, though the birds have reappeared in 1918. In Devon, Worcester, Cheshire, and Cumberland considerable decreases were noted, and some diminution in Kent, Surrey, and Middlesex, while no change is reported from Radnor and Beds."

2. *Nesting Habits*.—Further observations on the nesting habits of the Kingfisher are very desirable. All the nests I have met with have been in the banks of streams. I doubt if they are always dug out by the birds, as on two or three occasions I have found that the old burrows of the water-vole have been utilized, and in another case the hole was formed by part of the bank of the stream being washed away beneath the root of a tree.

In all the nests examined I have found an accumulation of fish-bones and other indigestible portions of food, and only these.

While in many cases I have failed to observe any attempt at arrangement of the different items, in others there is undoubtedly a very definite nest formed, described by Yarrell (10) as follows :—"The eggs are laid, sometimes on the bare soil, but at others on the fish-bones already ejected by the birds and allowed to accumulate until they amount to a handful or more. These bones are cast up as pellets, but are apparently worked by the bird's movements, as she sits, into the shape of a cup; and, whether by pressure, by the moisture of the soil, or by both, they generally cohere so as to form a very pretty nest, more than an inch deep and quite smooth within, which with care may be removed so as to preserve its structure."

During the time the young occupy the nest the passage leading to the terminal chamber becomes almost filled with castings, excreta, etc.

In many cases two broods are reared in the season. Here, in Fifeshire, I have never known more than one.

3. *Food brought to the Nest*.—Fish, tadpoles, crayfish, and

the larvæ of various insects have been observed in the bird's beak when alighting before entering the nest. Fish are sometimes held crosswise, in which case the bird jerks them upwards catching them head downwards. In other cases they are held lengthwise, either by the head or the tail, and swallowed, this action being accompanied by a throw-back of the head.

When newly hatched the young are fed by the parents, but after a time they frequently do no more than deposit the food about half-way along the passage. In some cases it is allowed to remain there and become trampled down into the putrid mass of material which has accumulated there.

4. *Depredations.*—The opinion is frequently expressed that the Kingfisher destroys large numbers of young trout, and such an opinion seldom loses anything in its repetition, so that among a certain class of people this bird has come to be regarded as an enemy and injurious to all fishing preserves and hatcheries.

As is frequently the case where the food of a bird is concerned, careful observation and investigation do not bear out or even lend any support to the views just mentioned. Indeed, one can scarcely imagine any other factor that would remove so many enemies of fish ova and fry with so little injury.

Unfortunately, once a bird is given a bad name, it is difficult to clear its character, and writers who should know better persist in repeating the inaccurate stories as to the number of fish destroyed, etc. The ultimate result of all this condemnation is that in many parts of the country the Kingfisher is shot down mercilessly, and is slowly but surely becoming rarer, much to the detriment of all trout streams.

#### IV. *Examination of Old Nests and Pellets.*

1. *Nest Contents.*—An examination of one hundred and twenty nest-contents shows them to consist entirely of animal remains, of which fish constitutes 59·5 per cent.,

injurious insects 15·5 per cent., neutral insects 4·5 per cent., crustacea 6·5 per cent., molluscs 5·5 per cent., tadpoles 4·0 per cent., worms 1·5 per cent., and miscellaneous animal matter 3·0 per cent.

The lightest nest-content weighed 12·5 grains and the heaviest 320 grains, the average being 142 grains. In all probability the heavier ones represent the contents accumulated over more than one season, but on this point I have no definite information.

Of the 59·5 per cent. of fish, minnows constituted 39·5 per cent., stickleback 31·0 per cent., gudgeon 14·5 per cent., trout 12·5 per cent., and 2·5 per cent. of unidentifiable fish-remains.

2. *Pellets*.—The average weight of the pellets was 15 grains. The analysis of the fifty-three specimens shows that they consist wholly of animal matter of which fish constitutes 59·0 per cent., injurious insects 15·0 per cent., crustacea 6·0 per cent., tadpoles 5·5 per cent., molluscs 5·0 per cent., neutral insects 5·0 per cent., worms 1·5 per cent., and miscellaneous animal matter 3·0 per cent.

#### V. *Examination of Stomach Contents.*

Practically all the stomachs examined were full. The average weight of the contents was 32·5 grains. Only twenty-seven stomachs have been examined. It was evident at a very early stage of this inquiry that the pellets and nest-contents afforded a very valuable source of information, and one which was in close agreement with the results obtained from the post-mortem examinations. It was, therefore, not thought desirable to destroy a large number of birds for the purpose of examining the stomach-contents. Many of those examined have been kindly sent to me by taxidermists, to whom the birds had been sent or brought to be set up.

1. *Nature of the Food*.—An examination of the stomach-contents shows that the whole of the food consists of animal matter. Specimens have been examined in all the months of the year excepting May, June, and December.

Unfortunately, I have not been able to obtain any birds feeding on river estuaries or near to the coast.

Analysis shows that of the total bulk of food consumed, fish of various kinds forms the major portion, viz., 63·5 per cent.; injurious insects, either adult or in their larval condition, form the next largest item, viz., 16·5 per cent., neutral insects constitute 6·0 per cent., molluscs 4·0 per cent., tadpoles and crustacea each 3·5 per cent., worms 1·5 per cent., and miscellaneous animal matter 1·5 per cent.

Only two items call for special remark, viz., the fish and the injurious insects.

A reference to Table II, showing the monthly percentages shows that fish-remains were present in the stomachs collected in every month; the highest percentage was taken

TABLE II.—Showing the monthly percentages of the food items of the adult Kingfisher.

	Jan.	Feb.	Mch.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Averages.
Fish .....	80·5	75·0	63·5	41·5	...	...	49·5	54·5	59·5	67·0	80·5	...	63·5
Tadpoles .	...	3·5	8·0	12·5	...	...	6·5	1·0	...	...	...	...	3·5
Molluscs .	2·5	4·0	2·5	1·5	...	...	2·5	4·5	6·5	7·5	4·5	...	4·0
Injurious Insects .	8·5	10·5	16·5	27·5	...	...	22·0	22·0	20·0	13·5	8·0	...	16·5
Neutral Insects .	1·0	3·0	4·5	11·5	...	...	10·5	9·0	6·5	5·5	2·5	...	6·0
Crustacea.	6·0	3·5	2·0	2·5	...	...	4·0	3·5	3·5	3·5	3·0	...	3·5
Worms ...	·5	·5	1·5	1·0	...	...	2·5	3·5	1·5	1·5	1·0	...	1·5
Miscell. ...	1·0	...	1·5	2·0	...	...	2·5	2·0	2·5	1·5	·5	...	1·5
Totals ...	100·0	100·0	100·0	100·0	...	...	100·0	100·0	100·0	100·0	100·0	...	100·0

in November and January, 80·5 per cent. in each month, and the lowest percentage in April, 41·5 per cent. It is significant that in the months when there are no fry or ova about, the percentage stands the highest; thus we have 75·0 per cent. in February, 67·0 per cent. in October, 63·0 per cent. in March, 59·5 per cent. in September, and 54·5 per cent. in August.

Tadpoles or very young frogs were present during five months, and the remaining food items occurred in each month.

The highest percentage of injurious insects was found in April, viz., 27·5 per cent., and the lowest, 8·0 per cent., in November. From observations made in the open this item was thought to be considerable, but the large percentage found from February to October was somewhat surprising. The species consist very largely of those that are classed as injurious because, either in their adult or larval condition, they feed upon fish ova and the fry, such for instance as the Dragon-fly (*Aeschna cyanea* Müll.), and all the species of Coleoptera.

Table III. shows the different percentages side by side of the food items obtained from the stomach-contents and the nest-contents and pellets, and the averages.

TABLE III. — Showing percentages and averages of the different food items found in (i.) the nest-contents, (ii.) the pellets, and (iii.) the stomachs.

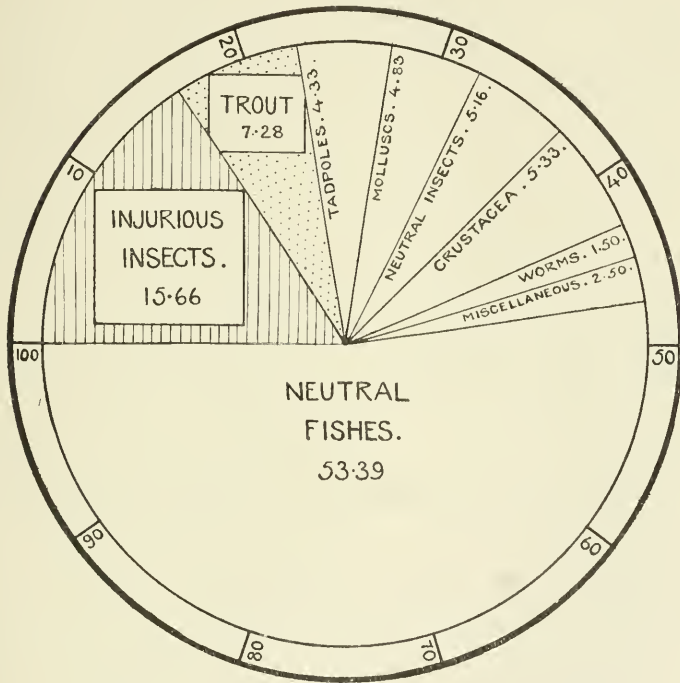
Food item.	Nest Contents.	Pellets.	Stomachs.	Averages.
Fish ... ..	59·5	59·0	63·5	60·67
Tadpoles ... ..	4·0	5·5	3·5	4·33
Molluses ... ..	5·5	5·0	4·0	4·83
Injurious Insects ... ..	15·5	15·0	16·5	15·66
Neutral Insects ... ..	4·5	5·0	6·0	5·16
Crustacea ... ..	6·5	6·0	3·5	5·33
Worms ... ..	1·5	1·5	1·5	1·50
Miscellaneous ... ..	3·0	3·0	1·5	2·50
Totals ... ..	100·0	100·0	100·0	99·98

Of the various species of fish four only could be identified. The minnow forms the chief item, totalling 39·0 per cent. of the total fish-content, the stickleback approaches this very closely with 32·0 per cent., then we have 15·0 per cent. of gudgeon and 13·0 per cent. of trout; the unidentifiable fish-remains were 1·0 per cent.



In view of all that has been laid to the charge of this bird, and especially its destruction of trout, the figures here given are worthy of very careful consideration. Moreover, it is important to note that in none of the stomachs was any trace of fish ova found.

Text-fig. 2.



The portion shaded by longitudinal lines represents food that it is beneficial the bird should eat; that stippled, food that it is injurious it should eat; and the blank portions food of a neutral nature.

Summarizing these figures, we find that 77.04 per cent. of the food is of a neutral nature, 15.66 per cent. is beneficial, and only 7.28 per cent. injurious (text-fig. 2).

If the estimate were taken upon only a local record, the injuries might possibly be shown to be greater, but estimated

upon the records from a number of districts there can be no doubt as to the economic status of this bird. The benefits it confers are twice as great as the injuries it inflicts, whilst the bulk of its food is of a neutral nature.

## 2. *Classified List of the Food.*

Amphibia.	Coleoptera.
Tadpoles and young frogs.	Large Water Beetle ( <i>Dytiscus marginalis</i> Linn.).
Fishes.	Great Water Beetle ( <i>Hydrophilus piceus</i> Linn.).
Minnow.	Small Water Beetle ( <i>Hydrobius fuscipes</i> Linn.).
Stickleback.	Whirligig Beetle ( <i>Gyrinus natator</i> Scop.).
Gudgeon.	
Trout.	Trichoptera.
Mollusca.	Caddis-flies, various species.
<i>Limnaea stagnalis</i> Linn.	Lepidoptera.
— <i>palustris</i> Müll.	Noctuid larvæ.
— <i>auricularia</i> Linn.	
— <i>percyra</i> Müll.	Diptera.
<i>Planorbis</i> sp.	River Sand-fly ( <i>Simulium</i> sp.).
Crustacea.	Harlequin-fly ( <i>Chironomus</i> spp.).
Crayfish ( <i>Astacus pallipes</i> Lereb.).	Phantom Larvæ ( <i>Corethra plumicornis</i> Fabr.).
Freshwater Shrimp ( <i>Gammarus pulex</i> Linn.).	Gnat ( <i>Culex nemorosus</i> Mg.).
Insecta.	Annélida.
Hemiptera.	Oligochæta.
Water Boatman ( <i>Notonecta glauca</i> Linn.).	Earthworm ( <i>Lumbricus</i> sp.) and cocoons.
Plecoptera.	Red-worms ( <i>Tabifex rivulorum</i> Müll.).
Mayfly ( <i>Ephemera vulgata</i> Linn.).	Hirudinea.
Odonata.	Small Pond Leech ( <i>Nephele vulgaris</i> Linn.).
Dragon-fly ( <i>Eschna cyauca</i> Müll.).	
Neuroptera.	
Alder-fly ( <i>Sialis lutarius</i> Linn.).	

## VI. *Summary and Conclusion.*

An examination of the contents of one hundred and twenty nests, fifty-three pellets, and the stomach-contents of twenty-seven Kingfishers, shows that the bulk of this bird's food consists of fish.

The species which go to form the total of 60·67 per cent. consist almost entirely of neutral species, 7·28 per cent. only consisting of trout.

The highest percentage of fish is consumed in the months of October, November, January, February, and March, and the lowest in April.

Insects, most of which are injurious to trout, constitute 15·66 per cent. of the total bulk of food, and the highest percentage is taken in the spring (March, April, and June), so that much of this material consists of voracious larvæ, most of which occasion a large amount of damage to fish ova and fry.

Only 5·33 per cent. of crustacea are taken, most of which are referable to *Gammarus pulex*, which species I am informed attacks the eggs of fishes. The consumption of worms and molluscs is only small.

A summary of the percentages of the various food items shows that 77·4 per cent. of the food is of a neutral nature, 15·66 per cent. is beneficial, and only 7·28 per cent. is injurious.

It is obvious, after considering the results obtained in this investigation, that the pisciculturist is grossly mistaken as to the economic position of the Kingfisher, and that despite the small percentage of trout that it destroys, it is really a very beneficial bird in that it destroys a much larger percentage of acknowledged enemies. Moreover, the little damage it occasions is not altogether beyond prevention.

In view of these results it is sincerely to be hoped that very strict and rigorous protection will be afforded this bird for the future. A clause in any new Act of Parliament affecting wild birds, making it an offence to stuff or set up specimens of the Kingfisher, excepting under a permit, would certainly tend to reduce the present senseless destruction.

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VIII.—*Obituary.*

## SIR JOHN ARTHUR BROOKE, Bt.

Sir John Arthur Brooke of Fenay Hall, Huddersfield, Yorks, who died on 12 July last, was a prominent man of business in the north and a Director of Messrs. John Brooke & Sons, Limited, worsted manufacturers, Huddersfield.

Sir John Brooke was born in 1844, and was the fourth son of the late Thomas Brooke. He was educated at Repton and Oriel College, Oxford, graduated B.A. in 1865, and was created a Baronet in 1919. His chief interests were in his business and in politics, and he was for many